AD_____

Award Number:
W81XWH-10-1-0959

TITLE:
Responsiveness of a Neuromuscular Recovery Scale for Spinal Cord Injury: Inpatient and Outpatient Rehabilitation

PRINCIPAL INVESTIGATOR:
Andrea L. Behrman, PhD, PT

CONTRACTING ORGANIZATION:
University of Florida, Gainesville, FL 32611-5500

REPORT DATE:
October, 2013

TYPE OF REPORT: Annual

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: (Check one)

□X Approved for public release; distribution unlimited

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
October-2013	Annual	30September2012-29September2013

4. TITLE AND SUBTITLE
Responsiveness of a Neuromuscular Recovery Scale for Spinal Cord Injury: Inpatient and Outpatient Rehabilitation

5a. CONTRACT NUMBER

5b. GRANT NUMBER
W81XWH-10-1-0959

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Andrea L. Behrman, Ph.D., P.T.
D. Michele Basso, Ed.D., PT
Craig Velozo, PhD, OT

email: cvelozo@phhp.ufl.edu

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
University of Florida
Gainesville, FL 32611

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Medical Research
and Materiel Command
Fort Detrick, Maryland,
21702-5012

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This multi-centered study (6 performance sites) assesses the responsiveness of the Neuromuscular Recovery Scale (NRS) for people with spinal cord injury. The NRS evaluates true recovery of pre-injury movement, rather than compensatory progress, during inpatient and outpatient rehabilitation for spinal cord injury. The coordinating site and six participating sites are respectively, the University of Florida and the Ohio State University, Frazier Rehabilitation Institute, Kessler Rehabilitation Institute, TIRR at Memorial Hermann, Shepherd Center, and Magee Rehabilitation Hospital. Enrollment and data collection continue at all approved sites with 100% of the outpatient population completed and 97% of the in-patient population completed both initial and discharge NRS evaluations. Web-site construction is under development through streaming web services and video production is underway) to provide an introduction to the NRS via video and an instructional guide. The NRS has been presented at the APTA Combined Sections and American Spinal Injury Association Meetings.

15. SUBJECT TERMS

Neuromuscular Recovery Scale (NRS), spinal cord injury, multicenter study

16. SECURITY CLASSIFICATION OF: U			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON** USAMRMC
a. REPORT U	**b. ABSTRACT** U	**c. THIS PAGE** U	UU	21	**19b. TELEPHONE NUMBER** *(include area code)*

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

Table of Contents

Introduction

The purpose of this study is to assess the responsiveness of the phase system (Neuromuscular Recovery Scale, NRS) in measuring recovery from SCI over time and across therapy settings. This scale uniquely detects return of normal function over time after SCI. Compensation for weakened or paralyzed muscles by stronger muscles, substitutions, or devices do not contribute to the score. Preliminary data indicate the current utility of the NRS to distinctly classify people with SCI based on performance of normal, pre-morbid movement function. Our intent is that the NRS will serve as a clinically-relevant SCI outcome measure for use in rehabilitation clinics, cohort studies, and randomized clinical trials.

Hypothesis

We hypothesize that individuals post-SCI undergoing physical rehabilitation will demonstrate significant change in Neuromuscular Recovery Scale scores from initial to discharge evaluations during the period of a) in-patient rehabilitation and usual care and b) outpatient rehabilitation (chronic SCI) receiving an intense, activity-based therapy.

Specific Aims

Aim 1: Assess the responsiveness of the Neuromuscular Recovery Scale for evaluating recovery from SCI over the period of 1) in-patient rehabilitation (sub-acute SCI) receiving usual care and 2) outpatient rehabilitation (chronic SCI) while receiving an intense, activity-based therapy.

A) Ninety-four patients, AIS A, B, C & D undergoing *usual* care rehabilitation in an inpatient setting during the sub-acute period post-SCI will be enrolled for completion of initial and discharge Phase System evaluations. We anticipate attrition will result in a study population of 72 subjects with initial and discharge evaluations.

B) Seventy-two NeuroRecovery Network (NRN) patients, chronic AIS A-D undergoing the standardized locomotor training program in an out-patient rehabilitation program will undergo initial and discharge evaluations. Only persons included in the NRN database having completed both initial and discharge evaluations will be included in our dataset.

Relevance

The results of this study will establish the ability of the NRS to detect rehabilitation-induced changes in recovery of function after acute or chronic SCI. By being able to classify initial functional deficits with the NRS, we will be able to better tailor interventions for each individual with SCI. By including VA and military personnel in the study, incorporation of the NRS in the care and treatment of soldiers or veterans with SCI will be immediate. Furthermore, web documents will support training of other military rehabilitation centers.

Body

Year 1: As outlined in our SOW, we dedicated considerable time attaining human subject approval, setting up procedures and attaining electronic data transfer approval for the Tampa VA, training the James A Haley VA Medical Hospital (Tampa VA) physical therapists and enrolling subjects. As we are leveraging the standard clinical practice of the NeuroRecovery Network (NRN) in routinely evaluating out-patients with the NRS at initial evaluation and discharge, we additionally incorporated three upper extremity items consistent with the NRN. These items were added to the NRS in May, 2011 and should assist in better gauging responsiveness as now the legs, trunk, and arms are all encompassed in the assessment. The approved IRB includes all of these items.

Task 1. Prepare and standardize all sites (NRN and Tampa VA) for data collection (Months 0-10)

1a. Planning meetings held among partnering investigators, statistician, and Systemax Corp.

- COMPLETED, YEAR 1

1b. Planning meeting held for NRN sites and Tampa VA with a) site PI and b) site Supervisors; ongoing monthly meetings scheduled

- COMPLETED,YEAR 1

1c. Prepare and submit IRB materials to each institution. Revise, as requested by IRB for approval.

- COMPLETED, YEAR 2 for the six NRN sites. Annual renewals completed for all six and the coordinating center at UF. The Tampa VA site's IRB is currently under review.
- COMPLETED, YEAR 3. Annual renewals completed for six sites. Tampa VA site was unable to achieve IRB approval in a timely manner in order to participate. (UF project coordinator orchestrated obtaining approvals).

Milestone #1 Human Use Approvals –

- Since our last report, one of the 7 NRN centers left the network without completing IRB or enrolling any subjects. Six NRN centers remain. YEAR 2

1d. Tampa VA study staff visits NRN-OSU clinical site for Phase System/NRS training. On-site competency skills checklist completed and passed.

- COMPLETED, YEAR 1

1e. After practice with 3-5 patients, Tampa VA completes and passes competency skills checklist for conducting NRS at Tampa VA site via submission of Phase System/NRS evaluation recording.

- COMPLETED, YEAR 2, refresher competency proposed during NCE

1f. NRN sites and Tampa VA site establishes procedures for patient/subject referral and data collection with in-patient rehabilitation SCI program

- **COMPLETED, YEAR 3. All sites competent and actively conducting evaluations (UoL); recruitment goals on target for completion led by AB. (UoL).** UF project coordinator provided oversight and maintained records documenting recruitment rates and success.

Milestone #2 All sites readied for data collection with Phase System instrument and in-patient SCI population

1g. Establish and modify database
- COMPLETED, YEAR 1

1h. Tampa VA site added to 7 NRN sites as a research site for data entry to database
- DATABASE COMPLETED FOR VA SITE, YEAR 2. Current database system relies on use of SS#. This has hindered the use of the database for data entry and delivery from the Tampa VA site. Alternative routes have been discussed and put in place for VA data entry.

1i. Develop website for dissemination of instrument at introductory level including on-line video demonstrations. (preparation for dissemination – Year 2)
- UNDERWAY, Year 2-video production and web site in development at OSU
- NEARING COMPLETION, YEAR 3. Website development by OSU nearing completion and video production underway.

Milestone #3. Active database for all partnering institutions and clinical sites
- COMPLETED, YEAR 2

Task 2 Determine responsiveness of the Phase System (9-20 months)

2a. Identify subjects from NRN outpatient Locomotor Training programs
- UNDERWAY and On-GOING (YEAR 2) at approved IRB sites (6 NRN sites)

2b. Collect NRS evaluation data at initial and discharge
- UNDERWAY and ON-GOING (YEAR 2) at approved IRB sites (6 NRN sites)

2c. Recruit subjects from Tampa VA & inpatient rehabilitation clinics (at NRN clinical sites)
- UNDERWAY and ON-GOING (YEAR 2) at 6 NRN sites and PENDING HUMAN SUBJECTS APPROVAL (Tampa VA site) (YEAR 2)

2d. Collect Phase evaluation data at initial and discharge
- UNDERWAY and ON-GOING (YEAR 2) at 6 NRN sites and PENDING HUMAN SUBJECTS APPROVAL (Tampa VA site) (YEAR 2)

2e. Data extractions requested from database, quality checks conducted.
- COMPLETED, YEAR 3, data collection for the outpatient population.
- UNDERWAY and ON-GOING, YEARS 2 & 3, data collection for the inpatient population. **(UoL and all sites, NCE requested for completion, at 97%)**

Milestone #4. Produce Interim Report: Recruitment and Enrollment
- COMPLETED, YEAR 1, 2, and **3, INTERIM REPORTs**

2f. Analyze phase data from 1) in-patient and 2) out-patient rehabilitation programs
- **COMPLETED, YEAR 3, 100% out-patient data collection (progressed from 72% complete in year 2).**
- **NEARING COMPLETION, YEAR 3 & NCE YEAR 4 (6 mos requested), 97% of in-patient data collected as of 10-11-13 which progressed from 19% in Year 2.**

2g. Write manuscripts

- **UNDERWAY and ON-GOING, YEARS 2 & 3 & NCE YEAR 4 (6 mos requested),** Manuscript in progress for outpatient responsiveness led by UF and OSU, **co-author AB, statistician, DL (UoL**)**.** Manuscript in progress for Introduction and Methods, and Data Preparation: quality control checks and cleaning for analysis
- Manuscript in progress for outpatient responsiveness led by **UoL (AB), UoL (DL), statistician.** Manuscript in progress for Introduction and Methods, and Data Preparation, analysis **(UoL, DL)**
- COMPLETION, 100% out-patient data collection, **YEAR 3 (UoL)**
- COMPLETION, 100% quality control checks and data cleaning and preliminary analysis, data preparation for manuscript for out-patient data, **YEAR 3 (UoL)**
- NEARING COMPLETION, 97% of in-patient data collected (as of 10-11-13), **YEAR 3, NCE Yr 4 (UoL)**
- UNDERWAY, quality control checks and data cleaning and preliminary analysis, data preparation for manuscript for in-patient data, **YEAR 3, NCE Yr 4, UoL**

- COMPLETE manuscripts and submit, **NCE, Yr 4, UoL**

Milestone #5 Final Report, Publications (2) and abstracts submitted for national conferences.

- COMPLETED, YEAR 2, 2nd Year Progress Report.
- No manuscripts submitted and no publications to date.
- COMPLETED, YEAR 2, Quad Chart completed and submitted.
- **COMPLETED, YEAR 3, Interim Report submitted (Behrman, UoL)**
- COMPLETED, YEAR 3, Request for Change in PI (Velozo to Tester, based on Velozo's departure from UF) submitted.
- COMPLETED, YEAR 3, Closed Tampa VA's subcontract (Tester - UF & Velozo - UF/MUSC). Redistribution of funds requested in NCE.
- **COMPLETED, YEAR 3, Request for NCE submitted by** UF (Tester - UF & Velozo - UF/MUSC), OSU (Basso), Behrman **(UoL).**
- **COMPLETED, YEAR 3, Abstracts submitted and presented to CSM, ASIA, and Military Healthcare (accepted, Dec. 2013) (Behrman – UoL,** Basso – OSU, and Velozo – UF/MUSC)
  Note abstract submitted to ACRM, not accepted

Milestone #6 Dissemination plan completed.

UNDERWAY and ON-GOING, YEARS 2 & 3, Finalize informative materials re: Phase instrument for distribution in publications and on-line.

3b. UNDERWAY and ON-GOING, YEARS 2 & 3, Finalize web-based introductory program to Phase Instrument.

3c. Distribute to VA Health Care System SCI facilities and NRN sites.

- COMPLETED, YEAR 2, Presented methods to NRN site at National Summit meeting of 6 sites, 2012.
- COMPLETED, YEAR 3, Research outcomes presented at National Summit, May, 2013 and presentation to all sites.

- Work with Tampa VA re: distribution to VA SCI Centers. UNABLE TO COMPLETE due to Tampa's lack of IRB approval and participation.

3d. Submit abstract for national SCI conferences and VA.

- **COMPLETED, YEAR 3, Abstract submitted and presented for Neuromuscular Recovery Scale (NRS) for presentation at American Spinal Injury Association Meeting, May 2013. (Behrman – UoL, primary author).**
- **COMPLETED, YEAR 3, Abstract accepted for Combined Sections Meeting, APTA, Jan. 2013, only methods to be presented in context of introduction of NRS. (Behrman, primary author, UoL).**
- **COMPLETED, YEAR 3; Invited lecture, Braintree Rehabilitation Conference, Nov. 2012, only methods to be presented in context of introduction of NRS as new outcome measure and potential utility (Behrman, UoL)**
- **IN PROCESS, Year 3: Invited to present at Military Healthcare conference, Dec 9-12, 2013, San Diego. Request in process for travel expenses (Behrman UoL**, Basso-OSU, Velozo – UF/MUSC), NCE – YEAR 4 (6 months**).**

Key Research Accomplishments, YEAR 3

Data Collection

- **In-patient enrollment and data acquisition is currently at 97**% (n=69) of the targeted population of n=72 subjects with both initial and discharge evaluations. Two are currently enrolled and we anticipate a 3rd by 10-31-13 to be enrolled..
- **Out-patient enrollment and data** collection is currently at 100% (n=72) and completed.

Data Analysis

- Quality control checking and data cleaning has been completed with the out-patient dataset (n=72).
- Data cleaning of in-patient data is underway.
- **Data analysis completed (YEAR 3, UoL)** and manuscript in preparation with out-patient population (led by Tester – UF and Basso – OSU; **Behrman UoL, co-author, DL, UoL, statistician;** Velozo, co-author). Complete during NCE – YEAR 4 (6 months), Request in process.
- Data analysis initiated and manuscript in preparation with in-patient population. Led by **Behrman UoL,** Basso, Velozo, Lorenz, Tester co-authors. **(YEAR 3) Complete during NCE – YEAR 4 (6 months), Request in process.**

Abstracts and Manuscripts

- **Two abstracts presented:**
  - **APTA Combined Sections Meeting, 2013, responsiveness study methods only reported and the NRS instrument introduced (Behrman – U of L**, Basso - OSU, Velozo – UF/MUSC, **YEAR 3)**
  - **ASIA Conference, May, 2013, responsiveness study methods only reported and the NRS instrument introduced (Behrman – U of L**, Basso - OSU, Velozo – UF/MUSC, **YEAR 3)**
  - **Invited to present at Military Healthcare conference, Dec 9-12, 2013, San Diego. Request in process for travel expenses (Behrman – U of L**, Basso - OSU, Velozo – UF/MUSC**), NCE – YEAR 4 (6 months).**

- Braintree Rehabilitation Conference, Nov. 2012, Boston, methods only reported and the NRS instrument introduced **(Behrman, UoL, Yr 3**)
- Brazilian NeuroPhysical Therapy Conference, Nov. 2012, methods only reported and the NRS instrument introduced **(Behrman, UoL, Yr 3)**
- 4th International Congress of Neuronal Plasticity and Brain Restoration, Merida, Mexico, Oct 2012, methods only reported and NRS instrument introduced. (Basso, OSU), YEAR 3

- **Responsiveness Manuscripts**
  - **Out-patient –Methods, Results, Discussion in preparation. NCE – YEAR 4 (6 mos).** Manuscript preparation led by Tester – UF (Proposed PI) and Basso – OSU, **Behrman, co-author**, Velozo, co-author.
  -
- **Responsiveness Manuscripts**
  - **In-patient –Methods, Results, Discussion in preparation. NCE – Yr 4 (6 months).**
  - **Data cleaning underway, data analysis and manuscript in preparation. Behrman (primary author, UoL), Lorenz, statistician)** Velozo, Tester, Basso, co-authors. **NCE – Yr 4 (6 months).**

Reportable Outcomes

Refer to abstracts for ASIA conference and CSM conferences.

Conclusion

We have completed IRB approval and renewals for Yr 3-4, with the exception of the Tampa VA which has withdrawn from the study. We have completed enrollment for the out-patient population and are at 97% for the in-patient population. We have initiated preparation for the web site for dissemination and videography of the assessments, presented 2 abstracts to national SCI and Physical Therapy conferences, and included an introduction to the instrument and methods at three invited presentations (one national, two international). We have been invited to present at the Military Healthcare conference in December 2013. We are requesting a no-cost extension for Yr 4 (6 months) to finalize data analysis and submission of manuscripts (Tester, Behrman, Basso, Velozo), complete videos and website dissemination (Basso-OSU), complete data checks and cleaning (Behrman-UoL), finalize all reports and IRB close-outs (Tester-Velozo, UF-MUSC), complete payments to all sites for fee for service evaluations and IRB management and data entry (Tester, UF), and present at Military Healthcare conference in Dec. 2013 (Behrman- UoL, Basso-OSU, Velozo-MUSC). Please note that Dr. Velozo has left the University of Florida in August, 2012. Dr. Tester has agreed to be the PI for the coordinating center at UF to the completion of the project. This was discussed with Trish Henry as a viable and appropriate solution. Dr. Tester has been instrumental in these last months in preparation for the NCE in collaboration with Dr. Velozo and in maintenance of all IRB records with Sarah Suter, Project Coordinator. The IRB has been approved with this temporary change of PI while under DoD review.

References

None

Appendices

None

CSM-2013

Title: A New Outcome Measure for Spinal Cord Injury Based on Pre-Injury Function Not Compensation: Neuromuscular Recovery Scale

ABSTRACT:
Quantifying recovery after spinal cord injury (SCI) in the clinic is a challenge. The few instruments specifically designed for SCI typically measure compensation. After SCI, a wide range of recovery occurs so that any new instrument must be sensitive, reliable and valid. The new Neuromuscular Recovery Scale (NRS) was developed and refined by clinicians and scientists in the Reeve Foundation NeuroRecovery Network (NRN), 7 outpatient clinical sites in the U.S. The NRS is innovative in that scores are based on normal, pre-injury performance criteria. This program will present the psychometric properties of the NRS including inter-rater and test-retest reliability and validity using item-response theory. Responsiveness assessment will be introduced. Descriptions of the items which comprise the NRS will be provided as will standardization procedures. Video case studies and hands-on demonstrations across complete and incomplete SCI by skilled clinicians will maximize learning and increase effective translation into clinical use. Interpretation of the scores and discussion of how they can be used to guide rehabilitation will be drawn from widespread use of the NRS in the NRN.

Objectives:
1. Compare and contrast the key factors in compensation-based instruments and the new Neuromuscular Recovery Scale (NRS).

2. Apply and interpret several items from the NRS.

3. Describe the inter-rater and test-retest reliability of the NRS when used to assess complete and incomplete SCI

4. Describe the validity of the NRS to assess complete and incomplete SCI.

5. Discuss the process (and potential utility) of developing new, clinically-relevant outcome measures for people with SCI.

REVISED OUTLINE OF TIME AND CONTENT

CONTENT	
Overview of the Topic and Course Objectives	3 min
Review of SCI-Specific testing instruments and Introduction of the NRS -SCIM, WISCI II, Requirements of a strong functional assessment instrument (reliability, validity, sensitivity, standardization, qualitative vs quantitative)	12 min
Use video examples of NRS items to train participants in application, scoring and interpretation	30 min
Discussion Q & A	5 min

Reliability - Inter-rater reliability, use of algorithm and numerical score (12 mins or >) -Test retest reliability (6 or < mins)	18 min
Topics - Frequency, Progression, Outfit - Map - Floor, Ceiling effects	20 min
Measuring recovery vs. stratifying patients	8 min
Video case study (from clinic) showing progression using NRS	12 min
PANEL DISCUSSION, Q & A (all presenters) Potential topics: - Adaptation of current NRS based on these results and clinical need (UE/Phase 4) Clinician - Use of the NRS in clinical Trials - Responsiveness testing underway	12 min

BIOGRAPHICAL INFORMATION FOR EACH SPEAKER

D. Michele Basso Ed.D., PT is currently professor and Director of Research for the School of Health and Rehabilitation Sciences at Ohio State University. Dr. Basso has an active basic science research program which focuses on cellular mechanisms of exercise and recovery after spinal cord injury. Her translational research initiatives include participating in the first multicenter clinical trial in neurorehabilitation for SCI (SCILT) as well as directing a Neurorecovery Network Center at Ohio State University. Translating basic science findings into novel clinical interventions is the driving mission for Dr. Basso and her lab which is funded by NIH. She has developed several functionally-based instruments for experimental SCI which are widely used by basic scientists. This expertise serves as the foundation for the presentation. Her training at Teachers College, Columbia University and 15 years of teaching physical therapy curriculum will also inform the presentation.

Andrea L. Behrman, PhD, PT, FAPTA is an associate professor and researcher focused on the recovery of walking after incomplete SCI and stroke based on principles of neuroplasticity and activity at the University of Florida. She has 20 years teaching experience in physical therapy and adult neurorehabilitation. She has contributed to several texts on SCI and rehabilitation of walking. She currently leads the Locomotor Training and Recovery Research Initiative at the University of Florida with the aim of developing the “best practice” for the recovery of walking after neurologic injuries and enhancing quality of life. She is also the Co-Director of the Christopher and Dana Reeve Foundation NeuroRecovery Network with a mission of infusing standardized evidence- and activity-based therapies into clinical practice. She is currently funded by NIH, VA RR & D, the Department of Defense and the Craig H. Neilsen Foundation examining walking recovery in adults post-stroke, examining adaptive locomotor training in animal models and the human condition of SCI, and examining responsiveness of the Neuromuscular Recovery Scale.

Craig Velozo, PhD, OTR is professor and associate chair of Occupational Therapy at the University of Florida and a Research Health Scientist at the Rehabilitation Outcomes Research Center (RORC) Research Enhancement Award Program (REAP) and the Brain Rehabilitation Research Center (BRRC) of Excellence at the North Florida/South Georgia Veterans Health System. His Doctorate of Philosophy in experimental

psychology was from Ohio University and his Bachelors of Science degree in occupational therapy is from Washington University School of Medicine in St. Louis. Dr. Velozo's research focus is on the development of functional outcome measures using Rasch measurement theory. Dr. Velozo's research team has developed computerized adaptive measurement of physical functioning for the Activity Dimension of the International Classification of Functioning Disability and Health (ICF) and functional cognition measures for individuals with traumatic brain injury and stroke. Dr. Velozo is a member of the American Occupational Therapy Foundation Academy of Research.
.

Jeffrey J. Buehner PT, MS is the lead physical therapist at the NeuroRecovery Network (NRN) at the Wexner Medical Center at The Ohio State University, dedicated to maximizing functional recovery in those suffering from SCI through Locomotor Training and other activity-based therapies. He has been involved with teaching and training assessment of functional recovery and functional progression within the NRN since 2007. He has contributed to several publications on SCI and the recovery of walking ability. He has also given several guest lectures to the Doctorate of Physical Therapy programs at The Ohio State University and Ohio University.

Elizabeth C. Watson, PT, DPT, NCS is the clinical supervisor of the locomotor training clinic at Magee Rehabilitation in Philadelphia, an outpatient rehabilitation clinic dedicated to advancing recovery of function after SCI using activity-based therapies. She is an adjunct professor and guest lecturer at Philadelphia- area physical therapy programs. In addition, she has presented and published case studies on locomotor training.

Sandra "Buffy" Wojciehowski PT, DPT is a Senior Physical Therapist at Kessler Institute for Rehabilitation in West Orange, NJ. She has been the clinical supervisor of the Christopher and Dana Reeve Foundation, Neuro Recovery Network, locomotor training program since 2009.

REFERENCE:

1. Behrman AL, Ardolino E, VanHiel L, Kern M, Atkinson D, Lorenz D, Harkema SJ. Assessment of functional improvement without compensation reduces variability of outcome measures after human spinal cord injury. Arch Phys Med Rehabil (accepted)

2. Jackson, A.B., C.T. Carnel, J.F. Ditunno, et al., Outcome measures for gait and ambulation in the spinal cord injury population. J Spinal Cord Med, 2008.**31**(5): p. 487-99.

3. van Hedel HJ; EMSCI Study Group. Gait speed in relation to categories of functional ambulation after spinal cord injury. Neurorehabil Neural Repair. 2009 May;23(4):343-50. Epub 2008 Nov 25.

4. Anderson, K., S. Aito, M. Atkins, et al., Functional recovery measures for spinal cord injury: an evidence-based review for clinical practice and research. J Spinal Cord Med, 2008. **31**(2): p. 133-44

5. Catz, A., M. Itzkovich, E. Agranov, et al., SCIM--spinal cord independence measure: a new disability scale for patients with spinal cord lesions. Spinal Cord, 1997. **35**(12): p. 850-6.

6. Steeves, J.D., D. Lammertse, A. Curt, et al., Guidelines for the conduct of clinical trials for spinal cord injury (SCI) as developed by the ICCP panel: clinical trial outcome measures. Spinal Cord 2007. **45**(3): p. 206-21.

7. Buehner JJ, Forrest G, Schmidt-Read, M, White S, Tansey K, BASSO DM (2011) Relationship between ASIA exam and functional outcomes in the NeuroRecovery Network Locomotor Training Program. Arch Phys Med Rehabil (accepted).

8. Forrest GF, Lorenz DJ, Hutchinson K, VanHiel L, BASSO DM, Datta S, Sisto S, Harkema S (2011) Relationships between balance and walking measures at baseline and after locomotor training in incomplete SCI: Impact of Functional Recovery. Arch Phys Med Rehabil (in press).

9. Bass0 DM, Fisher LC, Anderson AJ, Jakeman LB, McTigue DM, Popovich PG (2006) The Basso Mouse Scale for Locomotion (BMS) detects differences in recovery after spinal cord injury in five common mouse strains. J Neurotrauma, 23:635-659.

10. Velozo CA, Woodbury ML. Translating measurement findings into rehabilitation practice: an example using Fugl-Meyer Assessment-Upper Extremity with patients following stroke. J Rehabil Res Dev 2011;48(10):1211-22.

11. Woodbury M, Velozo CA, Thompson PA, Light K, Uswatte G, Taub E et al. Measurement structure of the Wolf Motor Function Test: implications for motor control theory. Neurorehabil Neural Repair 2010;24(9):791-801.

KEYWORDS
Outcome assessment; recovery of function; reliability; validity

TEACHING STRATEGIES AND INSTRUCTIONAL LEVEL
Dissemination of information will be through lecture, panel discussion, video demonstration & case study for Beginners to advanced.

EVALUATION METHOD: Question & Answer

AUDIO/VISUAL EQUIPMENT: LCD, AV Cart, Screen, laser pointer, CD/DVD Player with audio.

Unique Considerations: We need internet access to show videos, presentation software, etc.

SPEAKER INFORMATION
D. Michele Basso, Ed.D., PT
Professor, Director of Research
School of Health & Rehabilitation Sciences

106 Atwell Hall, 453 W. 10th Ave.
Ohio State University
Columbus, OH 43210

Basso.2@osu.edu

APTA # 51102.

Andrea L Behrman, PT, PhD, FAPTA
Associate Professor
PO Box 100154
Department of Physical Therapy
University of Florida
Gainesville, FL 32610-0154

abehrman@phhp.ufl.edu
APTA # 23576

Craig A. Velozo, PhD, OTR/L
Professor, Assoc. Chair – Department of Occupational Therapy
University of Florida
P.O. Box 100164
Gainesville, Florida 32610-0164

cvelozo@PHHP.UFL.EDU

Jeff Buehner, PT, MS
NeuroRecovery Network
The Wexner Medical Center at The Ohio State University- Dodd Hall
480 Medical Center Drive
Columbus, Ohio 43210

jeffrey.buehner@osumc.edu
APTA#: 249713

Elizabeth C. Watson, PT, DPT, NCS
1500 South Columbus Blvd
Magee Rehabilitation
Philadelphia, PA 19147

ewatson@mageerehab.org

APTA # 297079 (renewing)

Sandra Wojciehowski PT, DPT
Kessler Institute for Rehabilitation
1199 Pleasant Valley Way
West Orange, NJ 07052

Swojciehowski@Selectmedicalcorp.com

APTA # 398612

Course/Symposium Guidelines

Title of Course: Neuromuscular Recovery Scale: A New Measure of Recovery Based on Pre-Injury Performance

Type of Course: Instructional Course/Symposium

Educational Objectives:

1. Discuss the rationale and process of development of the NRS including utility.
2. Compare and contrast the key factors in compensation-based instruments and the new Neuromuscular Recovery Scale (NRS).
3. Conduct, score, and interpret several items from the NRS for clinical purposes (e.g. clinical decision-making, progression, and treatment planning) and research outcome.
4. Describe the inter-rater and test-retest reliability of the NRS when used to assess complete and incomplete SCI
5. Describe the validity of the NRS to assess complete and incomplete SCI.
6. Introduce responsiveness study.

Synopsis:

Quantifying recovery after spinal cord injury (SCI) in the clinic is a challenge, yet a timely need with advances in therapies targeting enhanced recovery post-SCI. While some measurement instruments specifically designed for SCI typically allow compensation, other measures such as manual muscle testing prohibit use of compensatory strategies during testing. The Neuromuscular Recovery Scale (NRS) was developed by clinicians and scientists in the Reeve Foundation NeuroRecovery Network (NRN), 7 outpatient clinical sites in the U.S. (Behrman et al. 2012). The NRS is innovative in that scores are based on normal, pre-injury performance criteria. For instance, the ability to stand up from sitting is assessed without use of load-bearing on the arms and with usual limb and trunk kinematics as the reference. This instructional course will introduce the instrument, its utility in practice and research. Items that comprise the NRS will be described, as will standardization procedures. Additionally, we will present the psychometric properties of the NRS including inter-rater and test-retest reliability and validity using item-response theory addressing a wide range of injury severity and recovery, and introduce responsiveness study. Video case examples with hands-on demonstrations across complete and incomplete SCI by skilled clinicians will maximize learning and increase effective translation into clinical use. Interpretation of the scores and discussion of how the NRS can be used to guide rehabilitation and as a clinical and/or research outcome will be drawn from widespread use of the NRS in the NRN.

Course Chair: Andrea L. Behrman, PhD, PT, FAPTA
Professor, Department of Neurological Surgery
University of Louisville
Louisville,
KY
andrea.behrman@jhsmh.org

Faculty: Elizabeth Ardolino, PhD, PT
Assistant Professor, Physical Therapy Program
University of St. Augustine
Austin,
TX
eardolino@ablescale.org

Marcie Kern, PT, MS
Physical Therapist III, NRN Clinical Supervisor
TIRR Memorial
Hermann
Houston,
TX
Marcie.kern@memorialhermann.org

Funding Source: Craig H. Neilsen Foundation, Christopher and Dana Reeve Foundation through a cooperative agreement with the Centers for Disease Control and Prevention (Award No. 1U59DD000838); Department of Defense-CDMRP-SC090246

Military Healthcare Dec 9-12, 2013, San Diego, CA

1) The Reeve Foundation NeuroRecovery Network: Standardized Activity-based Therapy, Outcomes, and Program Evaluation

2) Neuromuscular Recovery Scale: A New Measure of Recovery after Spinal Cord Injury Based on Pre-Injury Performance and Not Compensation

- Discuss the mission of the NeuroRecovery Network in advancing activity-based therapies and recovery after spinal cord injury across rehabilitation centers in the U.S. and Canada.
- Describe rationale for the Neuromuscular Recovery Scale (NRS) and how to conduct, score, and interpret several items of the NRS for clinical purposes and research outcomes.
- Describe the inter-rater reliability, test re-test reliability and validity of the NRS when used to assess individuals with complete and incomplete SCI (outpatient) and responsiveness of the instrument (outpatient/inpatient).

Speakers:

Andrea L. Behrman, PhD, PT, FAPTA
Professor, Department of Neurological Surgery
Director, Pediatric NeuroRecovery Program
Kentucky Spinal Cord Injury Research Center
University of Louisville, Louisville, KY

D. Michele Basso, EdD, PT
Professor and Director of Research, Associate Director
School of Health and Rehabilitation Science
Ohio State University, Columbus, Ohio

Craig Velozo, PhD, OTR
Professor and Division Director
Department of Occupational Therapy
Medical University of South Carolina
College of Health Professions, Charleston, SC

Andrea L. Behrman, PhD, PT, FAPTA is a professor and researcher at the Department of Neurological Surgery, the University of Louisville. She is focused on the recovery of walking after SCI through rehabilitation based on principles of neuroplasticity and activity. She has contributed to several texts on SCI and rehabilitation of walking. She is Director of the Pediatric NeuroRecovery Program and also the Co-Director of the Christopher and Dana Reeve Foundation NeuroRecovery Network with a mission of infusing standardized evidence and activity-based therapies into clinical practice. She is currently funded by the VA RR & D, the Department of Defense and the Craig H. Neilsen Foundation.

D. Michele Basso Ed.D., PT is currently professor and Director of Research for the School of Health and Rehabilitation Sciences at Ohio State University. Dr. Basso has an active basic science research program which focuses on cellular mechanisms of exercise and recovery after spinal cord injury. Her translational research initiatives include participating in the first multicenter clinical trial in neurorehabilitation for SCI (SCILT) as well as directing a Neurorecovery Network Center at Ohio State University. Translating basic science findings into novel clinical interventions is the driving mission for Dr. Basso and her lab which is funded by NIH. She has developed several functionally-based instruments for experimental SCI which are widely used by basic scientists. This expertise serves as the foundation for the presentation.

Craig Velozo, PhD, OTR is professor and chair of Occupational Therapy at the Medical University of South Carolina. His Doctorate of Philosophy in experimental psychology was from Ohio University and his Bachelors of Science degree in occupational therapy is from Washington University School of Medicine in St. Louis. Dr. Velozo's research focus is on the development of functional outcome measures using Rasch measurement theory. Dr. Velozo's research team has developed computerized adaptive measurement of physical functioning for the Activity Dimension of the International Classification of Functioning Disability and Health (ICF) and functional cognition measures for individuals with traumatic brain injury and stroke. Dr. Velozo is a member of the American Occupational Therapy Foundation Academy of Research.